V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Environmental and Water Quality Impacts

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	0%	0%	4%	
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	24%	
112	Watershed Protection and Management	0%	0%	4%	
123	Management and Sustainability of Forest Resources	0%	0%	6%	
133	Pollution Prevention and Mitigation	0%	0%	18%	
135	Aquatic and Terrestrial Wildlife	0%	0%	12%	
205	Plant Management Systems	0%	0%	7%	
212	Pathogens and Nematodes Affecting Plants	0%	0%	5%	
213	Weeds Affecting Plants	0%	0%	3%	
307	Animal Management Systems	0%	0%	3%	
402	Engineering Systems and Equipment	0%	0%	6%	
404	Instrumentation and Control Systems	0%	0%	4%	
721	Insects and Other Pests Affecting Humans	0%	0%	4%	
	Total	0%	0%	100%	

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	40.0	0.0
Actual	0.0	0.0	22.6	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	635152	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	1521364	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	772218	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

We are developing economic and policy data by accessing existing sources, generating data from computer models, and surveying market participants. This data is analyzed using appropriate statistical and econometric methods. Watershed scale model assessments are conducted utilizing field-level estimates of alternative management practices (AMPs). Changes in water quality in impaired watersheds resulting from the evaluation of AMPs are measured. The cost of meeting different water quality standards at different points within a watershed and the potential impact of different environmental policies on Tennessee's agriculture are evaluated. A model used to project land use change estimates the probability of land development of individual parcels as a function of parcel-level attributes.

Soil research is fundamental to our environmental program.The erosion, sediment transport, and contaminant transport capabilities of the RUSLE2 soil erosion model continue to be refined as the model's use increases nationally and around the world. Soil samples are thoroughly characterized in terms of elemental composition, particle size, mineralogy, and other soil chemical and flow characteristics using standard techniques. New methods for decreasing the expense of measuring soil properties by agricultural producers and fellow researchers are developed.

As new waste treatment approaches are introduced, we provide research-based evaluation of appropriate technologies for Tennessee. Background information on the water quality is collected in various watershed areas, including one where baseline environmental data is being used to evaluate the impact of a dairy production unit on the area.

2. Brief description of the target audience

This is currently a research-only targeted program, so the target audience is weighted toward basic/applied research clients.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	0	0	0	0
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2010
Plan: 1
Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	20	
Actual	0	28	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Reduce water-flux measurement error of heat-pulse probe, percent error (Lee).
  Not reporting on this Output for this Annual Report

Output #2

Output Measure

- GPS-based underwater video mapping has been successfully completed and analyzed for optimal habitat in the Driftwood River (Rayed bean mussel), Citico Creek (several endangered species), Obed Wild and Scenic River (Spot fin chub), and Big South Fork River and Recreation Area (various endangered mussel and fish). (Ayers)

Year	Target	Actual
2010	{No Data Entered}	1

Output #3

Output Measure

- Developed physics-based vehicle terrain interaction model for US Army. (Ayers)

Year	Target	Actual
2010	{No Data Entered}	1

Output #4

Output Measure

- The Eastern Native Grasslands Alliance is a cost-effective and very efficient way to expand the communication, knowledge, and cooperation of a wide array of stakeholders concerned with grasslands management in the eastern US. By linking many organizations and interest groups, common ground can be established leading to common action and in turn, far more progress than would otherwise be possible. (Gray)

Year	Target	Actual
2010	{No Data Entered}	1

Output #5

Output Measure

- The SMART Center has the potential to provide assistance to communities and other entities dealing with new stormwater regulations, helping train competent stormwater professionals, and providing research support for the development and testing of stormwater practices. (Buchanan & Yoder)

Year	Target	Actual
2010	{No Data Entered}	1

Output #6

Output Measure

- Developed a superior method to describe the area of a hole cut into a round pipe, which is necessary to accurately describe water flow through said hole. (Tyner)

Year	Target	Actual
2010	{No Data Entered}	1

Output #7

Output Measure

- Demonstrated the inadequacy of solely employing soil cores for determining the suitability of a water perching horizon across vast water impoundments that possess vertical drainage features, and demonstrates the application of continuous geophysical profiling technologies for subsurface profiling of landforms possessing seismic fissures. (Freeland)

Year	Target	Actual
2010	{No Data Entered}	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percent of Tennessee major row-crop acreage under some form of no-till or conservation tillage (Tennessee Agriculture 2007).
2	Greenhouse and nursery crop use of bioactive natural products in place of conventional pesticide on tomato, percent of operators adopting (Gwinn).
3	Design and use of geo-referenced snorkelcam (Ayers)
4	Development of bioassessment models (Gray)
5	Effect of perennial switchgrass soil carbon storage (Tyler)
6	Effects of bacteria and viruses on soil processes (Debruyn and Radosevich)
7	Spectral-based real-time crop health sensors (Wilkerson)
8	Pathogen fate and preferential flow in soil (Freeland)

Outcome #1

1. Outcome Measures

Percent of Tennessee major row-crop acreage under some form of no-till or conservation tillage (Tennessee Agriculture 2007).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	89	90

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation

Outcome #2

1. Outcome Measures

Greenhouse and nursery crop use of bioactive natural products in place of conventional pesticide on tomato, percent of operators adopting (Gwinn).

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation

Outcome #3

1. Outcome Measures

Design and use of geo-referenced snorkelcam (Ayers)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Better tools are needed to examine aquatic populations and their habitat.

What has been done
A new ?snorkelcam? snorkel mounted underwater videomapping system was developed by an undergraduate student and utilized in a TES mapping project at Citico Creek of the Cherokee National Forest. The team is now making multiple units to do more comprehensive snorkel mapping.

Results
The unit records geo-referenced video images for populations and species diversity, and shows the habitat/environment as well.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
135	Aquatic and Terrestrial Wildlife
307	Animal Management Systems
404	Instrumentation and Control Systems

Outcome #4

1. Outcome Measures

Development of bioassessment models (Gray)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is a need to preserve and enhance regional biodiversity in western Tennessee.

What has been done
Developed bioassessment models to monitor ecological restoration at hardwood bottomland sites enrolled in the Wetlands Reserve Program.

Results
Three important results: 1) Vegetation and bird community structure can be used to monitor state of ecological restoration, 2) frogs rapidly colonize bottomland restoration sites, and 3) salamanders use only mature forested wetlands.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
135	Aquatic and Terrestrial Wildlife
307	Animal Management Systems

Outcome #5

1. Outcome Measures

Effect of perennial switchgrass soil carbon storage (Tyler)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil organic matter is important in maintaining soil quality and soil productivity.

What has been done
Long-term study (in third year) sampling of soil CO2 in 700 acres of switchgrass.

Results

The use of the perennial crop, switchgrass for biofuel production has resulted in increases in soil organic matter of 1% or more in the fifth season compared to initial soil levels. Greater soil carbon storage will result in better soil and less carbon dioxide emission to the atmosphere.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
205	Plant Management Systems

Outcome #6

1. Outcome Measures

Effects of bacteria and viruses on soil processes (Debruyn and Radosevich)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Microorganisms (especially bacteria) are central to soil processes. It is thought that viruses that infect these bacteria should also be important to soil processes, however very little is known about soil viruses.

What has been done
Our work has contributed to a better understanding of the spatial and temporal dynamics of these organisms under different land management. A particular group of bacteria, the Gemmatimonadetes, is quite abundant in soils, suggesting they play an important role in soils.

Results
This group is not easily cultivated in the lab, therefore nothing is known of this role. We have obtained and characterized an isolate from this group, greatly advancing our understanding of their ecology.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
212	Pathogens and Nematodes Affecting Plants

Outcome #7

1. Outcome Measures

Spectral-based real-time crop health sensors (Wilkerson)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Crop sensors, in conjunction with previous yield history, can be combined to optimize nitrogen application rates within a field.

What has been done
We have conducted field evaluation of this technology for the last four seasons.

Results
Spectral-based, real-time crop health sensors are now being commercialized and adopted by producers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
101	Appraisal of Soil Resources
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
205	Plant Management Systems

404 Instrumentation and Control Systems

Outcome #8

1. Outcome Measures

Pathogen fate and preferential flow in soil (Freeland)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	{No Data Entered}	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil naturally safeguards groundwater from contamination. Fully understanding this filtering mechanism is essential, as zoonotic pathogens cause a large percentage of U.S. food-related illnesses and deaths. Most of the outbreaks are traceable to contaminated water exposure from uncooked foods or liquids that were improperly irrigated, rinsed, contained, or handled.

What has been done
This project's goal is to prevent zoonotic pathogens from entering into the U.S. food supply from agricultural production. Groundwater contamination occurs whenever the filtration capacity of soil is inadequate, overwhelmed, or bypassed. Conventional theory assumes non-preferential flow to supply sufficient time and surface area for the soil to filter contaminants. However, we have observed contaminants entering the groundwater regime via hydraulic transport by following long-established preferential flow pathways. Along these pathways, contaminants are supposedly filtered. Pathogen die-off and re-growth rates are largely unknown, as is also the filtration process for the wide variety of soil types.

Results
To safeguard groundwater supplies, knowing pathogen population decay rates from filtration, in-situ, over extended distances of natural gradient, as a function of time and distance from their initial deposition, is indispensable in establishing adequate design set backs away from protected water sources. Furthermore, precise subsurface mapping of preferential flow pathways allows for determining both pathogen source and fate, and implementing groundwater protection measures.

4. Associated Knowledge Areas

KA Code	Knowledge Area

112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
404	Instrumentation and Control Systems
721	Insects and Other Pests Affecting Humans

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Competing Public priorities

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- After Only (post program)
- Retrospective (post program)
- During (during program)
- Time series (multiple points before and after program)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}